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(54) Brushless dc motor and refrigerant compressor employing the motor

(57) A brushless DC motor minimizes a chance of dislocation or damage to an insulator used in the brushless DC motor. Slant portions are provided at end portions of the insulator; therefore, even if a nozzle of a machine for installing a winding should hit the insulator while moving between teeth, the insulator moves in a direction for coming in close contact with a slot aperture, i.e., in a direction substantially at right angles to a direction in which the nozzle moves. This arrangement prevents the insulator from moving by being pushed by the nozzle, making it possible to minimize a chance of occurrence of an insulation failure caused by a damaged or dislocated insulator.

FIG.1A

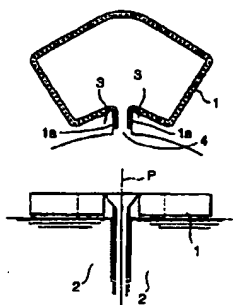
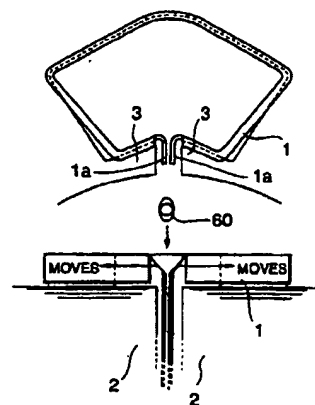


FIG.1B



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EUROPEAN SEARCH REPORT

Application Number
EP 00 11 3690

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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Y	* the whole document *	3,33,34	H02K1/14 H02K15/02
Y	US 4 685 201 A (BOYD JR JOHN H) 11 August 1987 (1987-08-11) * column 5, line 60 - column 5, line 68 *	3,33,34	H02K15/00 H02K29/03 H02K1/16
X	PATENT ABSTRACTS OF JAPAN vol. 018, no. 623 (E-1635), 28 November 1994 (1994-11-28) & JP 06 237545 A (TOSHIBA CORP), 23 August 1994 (1994-08-23) * abstract; figure 1 *	29	
X	PATENT ABSTRACTS OF JAPAN vol. 1996, no. 05, 31 May 1996 (1996-05-31) & JP 08 019202 A (FANUC LTD), 19 January 1996 (1996-01-19) * abstract; figure 9 *	30	
X	EP 0 772 275 A (FANUC LTD) 7 May 1997 (1997-05-07) * abstract; figures 1,2 *	29,30	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H02K
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 7 November 2000	Examiner Ramos, H
CATEGORY OF CITED DOCUMENTS		Y : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			

EPO FORM 1802 03.02 (P04C01)



European Patent
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Application Number

EP 00 11 3690

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-4, 29, 30, 33, 34

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 00 11 3690

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. Claims: 1-4,29,30,33,34

"brushless DC motor polyester film slot liner insulator with slant portions" to minimize chances of a slot insulation failure induced by a winding nozzle

1.1. Claim : 3

"bounding the coil connections in such a motor with a polyester thread" preventing loosening or sticking out (bulge) of connections from winding heads, and thus a winding insulation failure

1.2. Claim : 4

"use of rare-earth permanent magnets in such a motor to produce an intense magnetic field" allowing a reduction in size of the motor

1.3. Claims: 33,34

refrigerant compressor using such a motor

1.4. Claims: 29,30

"brushless DC motor with slot liner insulation opening narrower than slot opening" to secure sufficient dielectric strenght between coil and core

2. Claims: 5-10,14,25

2.1. Claims 5-7

"brushless DC motor with cut-out tooth portion" to reduce cogging torque

2.2. Claims: 8-10

"brushless DC motor with hole, groove or notch on tooth" to prevent magnetic short-circuit at time of rotor PM magnetization

2.3. Claim: 14

"brushless DC motor with given tooth shape" to prevent winding to overflow outside slots

2.4. Claim: 25

"brushless DC motor with fan-shaped tooth" to prevent

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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 00 11 3690

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

bulging and avoid coercive winding reshaping

3. Claims: 11-13,32

3.1. Claims: 11-13

"brushless DC motor with press-fit junction insert in choosen positionning spot" for higher productivity and reliability of the coil connection

3.2. Claim: 32

"brushless DC motor with choosen positionning of caulking spot" in order to minimize the effects on magnetic paths

4. Claims: 15,16

"brushless DC motor with buried connectors in slots" to prevent cooling failure due to the use of extra resin molding around connections if located in winding heads

5. Claims: 17-21

"brushless DC motor with removable spacer, or reinforced insulator, and folded insulating paper on winding heads" in order to strain relief the winding heads

6. Claims: 22-24,26-28

6.1. Claims: 22-24

"brushless DC motor with 7.5deg rotor or/and stator skew" to prevent cogging torque

6.2. Claims 26-28

"brushless DC motor with staggered or radially shifted PM rotor sectors" to reduce cogging torque

7. Claim : 31

"brushless DC motor with given slot shape" to increase coil occupancy and therefore motor efficiency



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 00 11 3690

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 00 11 3690

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-11-2000

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82